UCRL- 84084
PREPRINT

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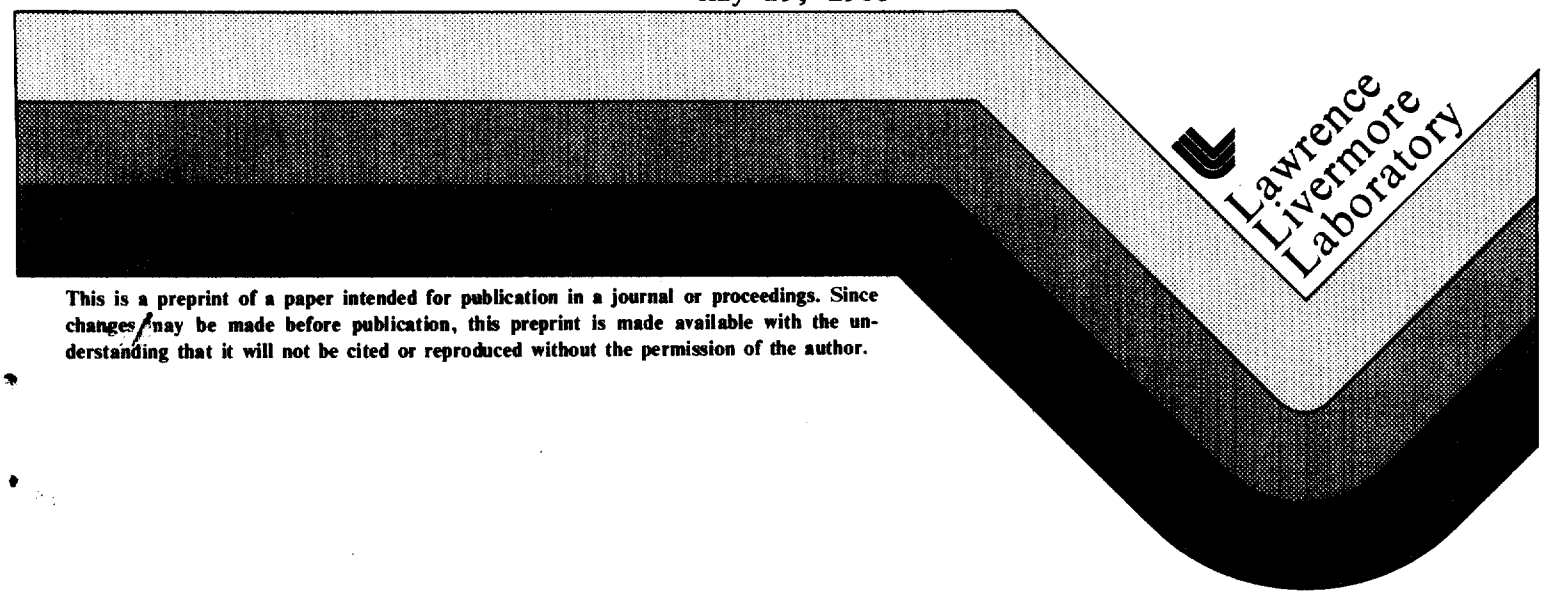
This Paper was Prepared for Submittal to
the Sixth Annual Underground Coal
Conversion Symposium

Afton, Oklahoma July 13-17
1980

May 29, 1980



ENVIRONMENTAL ASPECTS OF THE PROPOSED UCG PROJECT SITE IN WASHINGTON STATE*

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ABSTRACT

Lawrence Livermore National Laboratory is conducting an environmental assessment of the proposed underground coal gasification experiment in the Tono Basin near Centralia, Washington. This analysis is funded by the Department of Energy.

To satisfy the provisions of the National Environmental Policy Act (NEPA), the following elements are included in the assessment: (1) description of the proposed action and alternatives, (2) description of the existing environment, (3) potential environmental impacts of the project, and (4) agencies consulted to ensure coordination in evaluating effective mitigation measures.

Field reconnaissance and environmental data collected from both state and county agencies and from local individuals and organizations form the basis for an evaluation of the potential impact of the project on this riparian ecosystem. A cultural resource survey was also conducted as part of the site evaluation. Principal areas of concern include the potential for damage due to air emissions and groundwater contamination, maintenance of surface water quality and minimization of disruption of wildlife habitat. Possible mitigation measures to protect environmental quality are recommended.

INTRODUCTION

The Department of Energy has proposed that an underground coal gasification (UCG) experiment be carried out in the Tono Basin, located near Centralia, Washington. The project activity can be divided into four phases: (1) ranking of candidate sites for a UCG experiment in Washington State, according to resource potential and general geologic and hydrologic characteristics, (2) site selection and characterization of the Tono Basin site, (3) design of a UCG experiment for that site, and (4) execution of the proposed experiment.

To date, the site characterization work has been completed. Seismic survey work, along with testing in ten boreholes drilled in the targeted area, has provided data which will be used in the project design. The magnitude of the project and the details of the design have yet to be finalized.

One of the tasks assigned under phase 2 of the project was to prepare an environmental report of the site selected in the Tono Basin. Such a review of environmental characteristics of a proposed project is required under the National Environmental Policy Act of 1979 (NEPA)[1].

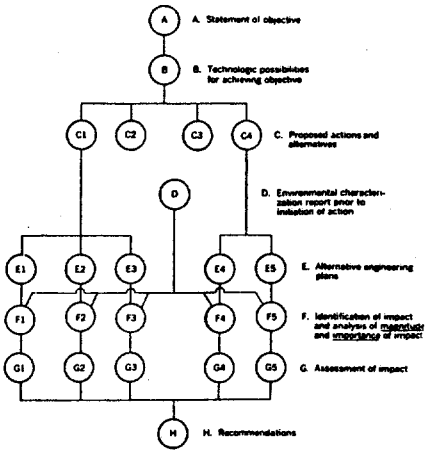
NEPA PROCESS

The purpose of NEPA is to ensure that environmental considerations become part of the Federal decision-making process. In order to implement this legislative mandate, the Council on Environmental Quality (CEQ) has promulgated guidelines for NEPA compliance.[2] These guidelines require that for all federal projects that one of the following NEPA documents be prepared: (1) Environmental Impact Statement (EIS), (2) Environmental Assessment (EA), (3) Finding of No Significant Impact. Such reports are designed to ensure that appropriate steps will be taken to minimize disruption of the environment.

One systematic way of performing such a required environmental impact analysis is presented in Figure 1.[3] The general procedure calls for a definition of the project objectives, consideration of technological possibilities and alternatives and the probable impact of a proposed action on the environment. The proposed plan of action, along with a report characterizing the existing environment, are both essential for determining the magnitude and significance of the impacts. A consideration of the impacts of alternative actions plays an important role in this processes.

The environmental characterization report (D) must provide detailed information on environmental variables which may be affected by the proposed action. Those factors which must be considered in such a characterization are listed in Table I.

*This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore Laboratory under contract No. W-7405-Eng-48.



FLOW CHART OF THE NEPA PROCESS

FIGURE 1

TABLE I

FACTORS CONSIDERED IN ENVIRONMENTAL ANALYSIS

- Topography, Physiography
- Climate
- Geology, Seismicity
- Hydrology (ground water, surface water)
- Vegetation
- Wildlife
- Air Quality
- Noise
- Socioeconomic conditions
- Archeological and Historic Resources

This type of information on existing environmental parameters may be collected from a number of difference sources. Characterization of these environmental factors and evaluation of the specific impact of a proposed action requires information gathering from a variety of sources. The task of environmental characterization includes those research activities listed in Table II.

TABLE II

ENVIRONMENTAL RESEARCH ACTIVITIES

Site Survey

- Biological/ecological analysis
- Archeological/cultural resource survey
- Pre-development monitoring/sampling

Information Gathering

- Library and archives research
- consultation with state/local officials
- contact with local citizens
- referencing of previously completed environmental reports

Evaluation of Environmental Data

Recommendation of Mitigation Measures

In accordance with these guidelines and procedures, an environmental analysis was performed at the proposed UCG site in Washington. A description of the environment provides the focus for the environmental analysis which concludes with recommendations for mitigating measures which may be taken to prevent serious damage to this riparian habitat.

DESCRIPTION OF THE ENVIRONMENT

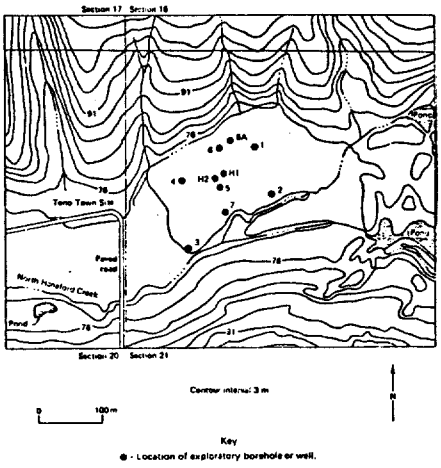
Our analysis has given us a picture of the environmental characteristics of the proposed UCG test site. Discussion below includes a summary of several of the major site characteristics including site location, seismological situation, soils, wildlife, and regional economy.

The site proposed for the underground coal gasification project is in the Tono Basin of Thurston County in western Washington State. See Fig. 2. The project area lies in Township 15N, Range 1W, Sections 20 and 21 near the border between Thurston and Lewis Counties. The topography of this region is marked by a series of low northwest trending hills with valleys between. The project area occupies a meadow in the North Hanaford Creek Valley at an elevation of about 240 feet. The surrounding hills range in elevation from 400 to 480 feet. See Figure 3. The area is considered to be "relatively quiet" seismologically with no active fault systems.[4]

LOCATION OF THURSTON COUNTY, WASHINGTON

FIGURE 2

Thurston County has a climate with mild temperatures in both summer and winter with the greatest precipitation falling between the months of October and May. Ground water recharge from precipitation occurs during the months of October to April. The

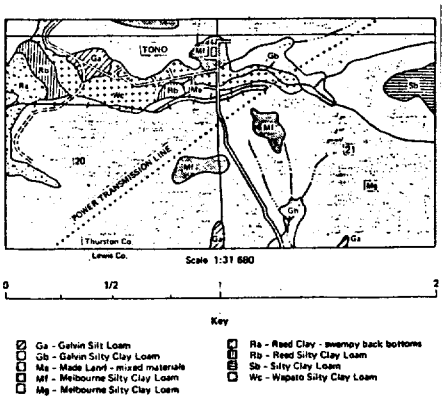


WASHINGTON UCG EXPERIMENT SITE

FIGURE 3

remaining five month dry period is one of peak water demand and little ground water recharge.[5]

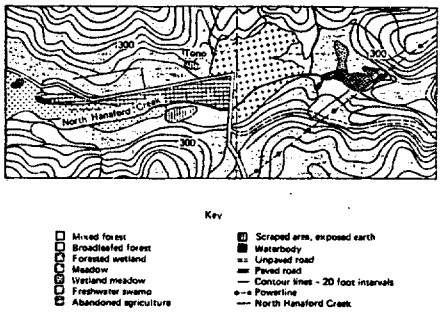
The proposed project site lies in a small meadow which is composed of silty-clay-loam soils which are water saturated throughout much of the year and are subject to ground settlement due to oxidation of peaty matter. The surrounding hills have silty-clay-loam soils which are highly erodible[6] but are generally free from landslide hazards in the area adjacent to the project site.[7] See Figure 4.



SOILS IN THE VICINITY OF THE TONO BASIN

FIGURE 4

In this region of Thurston County, the majority of the forest is limited to rolling hills. The lowlands have been cleared for agricultural and residential use or are covered with grasses. The project site is no exception. See Figure 5. The forest growth is secondary and tertiary due to logging and burning after settlement in the early 1900s. It is composed of broadleaf forest dominated by red alder with intermixed Douglas fir. Along the North Hanaford Creek, the forest is riparian in character and includes alder, vine maple, blackberries, salal, ferns, and a thick leaf litter floor. The meadow itself is composed of grasses, sedges, and forbs, and several large bushes of scotch broom and blackberries. The surface is water saturated much of the year and has been chronically disturbed by human activity. The coal mining town of Tono once lay to the west and northwest of the site. The meadow served as a grazing pasture for the Tono mine mules and was also the site of two powder storehouses.



VEGETATION OF THE TONO BASIN

FIGURE 5

There are no rare, threatened, or endangered species of plants or animals on the project site or in nearby areas.[8] The region provides good winter range for both small and large animal species including rabbit, opposum, raccoon, deer, and occasional bobcat, coyote, black bear, cougar, and Roosevelt elk. North Hanaford Creek does not support a salmon population, probably due to the lack of spawning gravels.

Thurston County's primary economic activities are lumbering and agriculture. Farms are small and mostly in pasture. The project region is predominantly woodland and forest with some cropland and pasture, but the project site has not been used agriculturally for some time. The nearest major industrial activity to the site is the Washington Irrigation and Development Corporation's surface mine in Lewis county and the associated power plant. The project site is on WIDCO's property. The nearby town of Centralia is a regional retailing center.

ENVIRONMENTAL IMPACTS AND MITIGATING MEASURES

Because the final DOE gasification test design has not yet been chosen, estimates of possible impacts of the activity are not certain. Both the final project physical design and the length of operation are unclear at this point. Despite this

uncertainty, estimates can be made as to the probable impact of the activity and the possible mitigating measures which may reduce the severity of the impacts. Of the many environmental variables covered in an environmental analysis, we chose three to discuss here because of their greater probability of being problem areas in a UCG experiment. They are (1) surface disturbance (subsidence, and disruption of vegetation and wildlife populations), (2) water quality, and (3) air quality.

Surface Disturbance

Alternative DOE gasification test design plans share several characteristics: they require site preparation to allow for the drilling of approximately 20 boreholes, the emplacement of monitoring equipment, the siting of office and storage trailers, the possible use of a six megawatt turbine, and the emplacement of a flare or incinerator to combust gas when the turbine is not using product gas for electrical generation.[9,10] Plans propose a surface covering of a foot of gravel and another foot of barkchips in order to make the soggy surface useable for the experiment.[11] All these activities, particularly the use of this surface cover, will essentially eliminate flora and fauna for some time after the project is completed. Mitigating measures would include minimizing surface area disturbed by confining the extent of development at the site. At the conclusion of the project, it is recommended that the site be restored as far as possible by careful grading and reseeding with native grasses.

Subsidence at UCG sites has been experienced both by Soviet and U. S. Investigators Core analysis at the Tono Basin site has not yet been completed, so estimates on the probability of subsidence are difficult to make. However, the depth of the experiment and the competence of the overlying structures do reduce the probabilities of subsidence, particularly for a small scale test.[12]

Water Quality

Surface Water Quality

Water quality of the North Hanaford Creek has been monitered because of WIDCO's use of the upstream pond (strip pit) as a drain for the abandoned Tono Mine (which serves as a settling basin for coal sludge disposal). This is a potential source of toxic metal and particulate contamination upstream of the proposed UCG site. Also, the fact that the North Hanaford Creek drains previously deep-mined and surface-mined land may have an impact on surface water quality.

Characterization work at the proposed site included the use of explosives for the site survey and the disturbance of the surface during the drilling of 10 boreholes. These activities resulted in some temporary changes in surface water quality. Removal of water from the creek upstream of the site, increased vehicular traffic on site and drilling and surface preparation activities all contributed to temporary increases in sediment load and suspended particulates in the creek.

Even larger increases in sedimentation in the creek may be expected during the site preparation and execution of the actual UCG experiment. Activity on site will include vehicular traffic, borehole drilling, and the grading and site preparation necessary for the emplacement of machinery and trailers.

The occurrence of low flows is a critical factor in water quality in the North Hanaford Creek. Minimum flows occur between August and January[13] and are influenced by natural storage capacity and climatic variability. The Chehalis region is susceptible to droughts of several years duration.[14] Hanaford Creek, including its tributary the North Hanaford Creek, has been closed to surface water use from May 1 to October 31 since 1952.[15] Sandia Corporation obtained a permit from Washington State to use the small pond upstream of the site as a source of water for drilling mud during the characterization phase. Approximately 70,000 gallons were withdrawn over 70 days between August and November, 1979.

Mitigation measures are recommended in order to reduce the impact of experimental activities on the North Hanaford Creek. Before other site preparation is begun, berms and levees should be constructed in order to prevent the discharge of sediment and liquid effluents, including drilling mud, into the creek. Surface waters should be taken only by permit issued by Washington State authorities. Water should not be removed if sediment load in the creek has appreciably increased. Periodic water quality monitoring would be recommended along the North Hanaford Creek above and below the site in order to check for the introduction of toxic materials or increased sediment load.

Ground Water Quality

In Thurston County, the lowlands are manteled with Quaternary Age deposits of course-grained materials such as gravel, sand, and conglomerates. These deposits are a major supplier of useable ground water in the region. Many of the people in the

Chehalis region are supplied by ground water sources.[16] The proposed project site shows no alluvial or recessional outwash deposits[17] although these do appear further downstream. This relieves the potential problem of near surface aquifer contamination from interconnectons created by inadequate or seismically sheared well casing, or leaks to the surface by way of fractures induced by subsidence over the gasification cavity.

In situ combustion and pyrolysis of coal loads the formation with a variety of soluble organic and inorganic substances that may become ground water contaminants. These substances include the coal ash and the organic products of combustion and pyrolysis. Of particular concern are the volatile organic substances transported by gases into the coal seam and the soluble compounds dissolved into ground water as it percolates through the gasification zone following the gasification procedure. Localized ground water contaminaton could occur. The volatile organic compounds such as phenols, may be brought to the surface through the production wells where they can be disposed of, but some fraction will remain in the reaction zone and the surrounding coal seam as contaminants.

Sorption and filtration of the contaminants by the coal as ground water passes through may limit the spread of the contaminants. Ground water flow speed plays and important role in determining the extent of contaminant spread from a UCG site. The Big Dirty coal seam is an aquitard, not an aquifer, and occurs in sedimentary rocks (Skookumchuck Formation) that yeild little water to wells and springs. Any localized contamination of the Big Dirty seam and associated strata by the proposed UCG test will not have a profound effect on the local water supply source.[18] Modeling the movements of such contaminants will be possible only when a design test plant is available and when a structural model of the site is provided.

Adequate mitigation measures for preventing or reducing the impact of ground water contamination by UCG are not yet developed. It is therefore particularly important to carefully model the experimental situation before undertaking a project with potentially irreversible ground water impacts.

Air Quality

Air patterns in the valleys of the Chehalis Basin are influenced by factors such as (1) position and intensity of the semi-permanent high and low pressure regions over the Pacific Ocean, (2) distance and direction from the Pacific, and (3) terrain. The predominant meterological feature is the abundance of precipitation which falls as rain or snow between October and February.

The only large, point source of air emissions in this area of Washington is the Centralia Steam Plant. Some data on emissions of SO_2, NO_x and particulates from this plant are available.[19] However, to determine the relative contribution of the UCG experiment to air pollution levels it is necessary to set up a pre-operation monitoring station at the site.

The magnitude of this impact is difficult to estimate at this time. This will be strongly dependent on the magitude of the gasification experiment, the use of the product gas at the site and the possibility of leakage of pollutants due to subsidence-induced surface cracking.[20] The gas produced and flared at the wellhead would contribute H_2O, H_2, CO, CO_2 and particulates to the atmosphere. Levels of SO_2 are expected to be low due to the low sulfur content of the Tono Basin coal (.75% by weight). The relatively high ash content of the this low-BTU coal (approximately 40%)[21] might exacerbate the particulate emission problem.

Activity-related air pollution will be significant during the experimental period. Equipment operation and surface disturbance will result in air emissions of NO_x, CO, HC and particulates. Control of these sources will be difficult because of their diffuse nature.

It is recommended that certain mitigation measures be taken to lessen the local impact of this air pollution source. Should high levels of pollutants be detected in the product gas, the installation of control technology is advised. Particulate or gas scrubbers might be needed to remove pollutants from the flare or turbine exhaust should a gas turbine be installed at the site. Air quality monitering should be conducted throughout the experiment to insure that air emissions at the site do not exceed standards.

CONCLUSIONS

In accordance with the Natonal Environmental Policy Act, the Department of Energy must consider environmental factors when planning for its energy development projects and incorporate necessary mitigation measures into final project plans. This UCG experimental design will therefore be finalized after consideration of the potential for significant environmental damage at the site. Advance planning for environmental protection will include the evaluation of

alternate mitigation strategies to prevent such deterioration. This will insure that environmental quality is protected in this part of Washington State.

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